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NEW OBSERVATIONS ON THE ORIGIN OF THE GALAPAGOS ISLANDS, WITH REMARKS ON THE GEOLOGICAL AGE OF THE PACIFIC OCEAN.

By G. Baur, Ph. D.,

ASSOCIATE-PROFESSOR OF PALEONTOLOGY, UNIVERSITY OF CHICAGO.

No. II.

THE GEOGRAPHICAL DISTRIBUTION OF DIFFERENT ANIMALS IN THE PACIFIC AND INDO-PACIFIC OCEANS.

We will now examine the distribution of a number of animals in the Pacific, in order to find out how this distribution agrees with the theories of the origin of this Ocean.

Ortmann[28] has shown that there is a uniform Indo-pacific Litoral Region.

Distribution of Pocillopora Lam.

Pocillopora,[29] a coral of the Madreporaria, is found only in the Indo-pacific region. It is represented by an extraordinary large number of forms reaching north to the Loo Choo and Sandwich Islands, and it is also common on the west coast of America. It is totally absent, however, from the Caribbean or West Indian Sea and the eastern American coral region. A few fossil forms are known since the miocene, *Pocillopora madreporacea* (Lam.), from Dax and Turin.

It is of the highest interest, that the members of the Decapod Family Trapeziidæ[30] shows exactly the same distribution as Pocillopora. I am greatly obliged to my friend Dr. Ortmann for calling my attention to this fact. In his recent paper on the geographical distribution of the Trapeziidæ, he makes the following remarks: "It is a very important fact, that all the members of this family are limited to an exceedingly peculiar habitat, the coral reefs; only a single species, *Quadrella coronata*, is said to occur between pearl-shells in the Panama Bay; but this case is certainly an exceptional one. All the other species are known from coral reefs. The Trapeziidæ are especially inhabitants of *living* corals, and live between the network of their fine branches. This mode of life characterizes them as typical littoral forms, which are found from the tidal zone to the same approximate depth to which the corals reach; the greatest depth mentioned is 22 fathoms in *Trapezia cymodoce* (Herbst)."

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[28] Ortmann, Arnold E. Grundzüge der marinen Thiergeographie. Jena, 1896.

[29] Ortmann, A. Studien über Systematik und geographische Verbreitung der Steinkorallen. Zoolog. Jahrb. Abtheil. f. System., II, Band, p. 143-188, Tafel VI, 1888.

[30] Ortmann, Arnold E. Die geographische Verbreitung der Decapoden Familie Trapeziidæ. Zool. Jahrb., Abth. f. System., X, Band, p. 201–216, 1897.

I shall now give the geographical distribution of the Trapeziidæ from Ortmann.

Geographical Distribution of the Decapod Family Trapeziidæ.

Trapezia Latreille 1825.

1. *Trapezia cymodoce* (Herbst) 1801.

Distribution: Probably everywhere in the Indo-Pacific littoral region, where coral reefs are found, from tide mark to 22 fathoms; Red Sea; East Africa: Dar-es Salaam; Glorioso, Amirante Islands, Seychelles; Maledives; Southern India; Ceylon; Mergui Islands; Singapore; Java; Borneo; Philippines; Loo Choo Islands; Moluccas; New Guinea; Queens land; New Caledonia; Fiji Islands; Tongatabu; Tahiti; Marquesas Islands.

2a. *Trapezia ferruginea dentata* (Macleay), 1838.

Distribution: Sulu Islands; Pelew Islands; Fiji Islands; Tongatabu; Samoa Islands; Tahiti; Paumatu Islands.

2b. *Trapezia ferruginea* Latreille, 1825.

Distribution: Red Sea; Zanzibar; Mauritius; Seychelles; Ceylon; New Caledonia; Samoa; Tahiti; Marquesas; Sandwich Islands; Panama Bay: Pearl Islands; Acapulco.

2c. *Trapezia ferruginea guttata* Rüppel, 1830.

Distribution: Red Sea; Seychelles; Loo Choo; Fiji; Samoa Islands; Tahiti.

2d. *Trapezia ferruginea maculata* (Macleay), 1838.

Distribution: Red Sea; Zanzibar; Glorioso Group and Amirantes; Rodriguez; Ceylon; New Caledonia; Samoa; Tahiti; Sandwich Islands; west coast of Mexico: Socorro Islands.

2e. *Trapezia ferruginea areolata* Dana, 1852.

Distribution: Ceylon; Nicobares; Java; Celebes; Amboina; Sulu Sea; Loo Choo Islands; New Caledonia; Fiji; Samoa Islands; Tahiti.

3a. *Trapezia rufopunctata* (Herbst), 1799.

Distribution: East Africa: Dar-es-Salaam; Ceylon; Tuticorin; Java; Philippines: Samboangan; Amboina; Samoa; Tahiti; Marquesas; Sandwich Islands.

3b. *Trapezia rufopunctata flavopunctata* Eydoux et Souleyet, 1841.

Distribution: Mauritius; New Caledonia; Tahiti; Sandwich Islands.

4a. *Trapezia digitalis* Latreille, 1825.

Distribution: Red Sea; Mauritius; Marquesas Islands; west coast of Central America; Panama Bay; Pearl Islands: Veragua; Cape St. Lucas.

4b. *Trapezia digitalis speciosa* Dana, 1852.

Distribution: Mauritius; Paumotu Islands.

4c. *Trapezia digitalis bella* Dana, 1852.

Distribution: Paumotu Islands.

Tetralia Dana, 1852.

1. *Tetralia glaberrima* (Herbst), 1790.

Distribution: Red Sea; Zanzibar; Dar-es-Salaam; Ibo; Natal; Madagascar; Nossi Bé; Rodriguez; Amirantes; Seychelles; Southern India; Java; Hong Kong; Loo Choo Islands; Amboina; New Caledonia; Fiji; Tongatabu; Tahiti; Paumotu; Marquesas Islands.

Quadrella Dana, 1852.

1. *Quadrella coronata* Dana, 1852.

Distribution: Indian Ocean; Providence Island; Sulu Sea; Panama Bay: Pearl Islands, between pearl shells.

Ortmann makes the following remarks: "The distribution of the Trapeziidæ is very simple but characteristic, and agrees very well with the limitations of the modern geographical regions of animals. Wherever in the whole Indo-Pacific area coral reefs are found, there are also *Trapeziidæ.* Most of the species and subspecies extend over the whole Indo-Pacific region, from the Red Sea and East Africa to the Loo Choo and Sandwich Islands, to Queensland in Australia and to the Paumotu Islands [and even the west coast of Central America]. Some forms, according to the present data, seem to be a little more limited, for instance, *Trapezia ferruginea dentata* has not yet been recorded from the Indian, but is found from the Sulu Sea eastwards; *Trapezia ferruginea areolata* is known eastward from Ceylon; *Trapezia digitalis bella* only from the Paumatu Archipelago. It is quite possible, however, that these forms will be discovered later in those places where they at present have not yet been found. Some species (*Trapezia digitata speciosa* and *Quadrella coronata*) have been found only in few isolated places, but these places are so far distant from each other, that we can assume with certainty their general distribution, even if they might be rare forms.

At the west coast of America it is not possible to distinguish any well characterized peculiar species; the four species mentioned from this region are also found in the Indo-Pacific region. Therefore, we must conclude, that the west American Region received these species from the Indo-Pacific. How these forms were able to pass the barrier of the open Pacific Ocean, can only be guessed. Migration along the North Pacific shore line is impossible, the Trapeziidæ being exclusively tropical forms; the conditions of former geological times can not be considered, since this family, as will be seen immediately, is of very recent age. Only one supposition remains, that the *Trapeziidæ* possess means of migration in free swimming planctonic larvæ, which enable them to reach inside the tropics, the western coast of America from the Pacific Islands. This, however, remains a simple supposition; we know nothing whatever about the propagation and development of the *Trapeziidæ* and about their eventual larvæ."

Ortmann believes that this is also the reason why so few forms of the Trapeziidæ are found in the West American region. After this he makes some very important remarks about the geological age of the Trapeziidæ.

"The distribution of the Trapeziidæ also demonstrates an important fact, which is of significance for the consideration of the geological age of this family. While represented on the western side of America, it is *totally* absent from the eastern side, especially in the West Indian Seas, so rich in corals. This fact is to be considered still the more, since the West and East American littoral regions show considerable relationship. This resemblance, however, must be explained by the former history of the American seas; that is, the well known and generally accepted union between the Caribbean Sea and the Pacific Ocean, which existed in the middle of tertiary time. The fact that the *Trapeziidæ* were unable to migrate into the Caribbean Sea, indicates that the land connection between North and South America was already finished during the time of their origin or their immigration into the West American littoral region, preventing their further eastern advance. From this reason we have to consider the Trapeziidæ as a relatively young family, which can not be older than the formation of this land barrier; that is, not older than Middle Tertiary (Miocene), but possibly still younger.

"Especially the Trapeziidæ indirectly prove that the relations between the tropical West Indian and tropical Indo-Pacific faunas can only be explained by a connection in *former* times, which does no longer exist, for they demonstrate that a group of animals, arising in the Indo-Pacific region after its isolation in its present form, and which seems to have the power to pass over extensive areas of the sea, was unable to reach the eastern American region. The Trapeziidæ could pass the barrier of the open Pacific and thus reach the western coast of America, but they could not enter the Atlantic Ocean; on one side they were prevented by the Isthmus of Central America, on the other side they could not pass the southern point of Africa, which is doubtless caused by the prevailing conditions of temperature in that region."

The general distribution of Pocillopora and the Trapeziidæ in the Indo-Pacific region, can only be explained by a former land connection of this region. Let us suppose for one moment that the Pacific Islands had been elevated gradually by volcanic activity, how was it possible that Pocillopora and at the same time the Trapeziidæ reached all these islands? There were no corals or Trapeziidæ near these islands which were elevated from the ocean. If we consider the Pacific Islands as the remains of a former Pacific continent, we have no difficulty whatever in explaining the general distribution of Pocillophora and the Trapeziidæ. Both are of recent origin (miocene) and demonstrate that the Pacific continent must have still existed just before this time. I have shown that the Galápagos Islands were separated from Central America during the miocene, and the geology of the Fiji Islands shows that the first sedimentary strata are also miocene.

We may now examine the distribution of a family of Decapods, the *Atyidæ,* which is confined to the fresh-water.[31]

Geographical Distribution of the Decapod Family Atyidæ Kingsley.

ATYIDÆ.

Hiphocaris v. Martens, 1872.

1. *Hiphocaris elongata* (Guèrin), 1857.

Distribution: Fresh-waters of the Antilles; Cuba; Hayti; Dominica; San Domingo.

2. *Hiphocaris compressa* (de Haan), 1849.

Distribution: Fresh-water of Australasia; Japan: Yokohama, Tokio; Island of Adenare, near Flores; Queensland: Burnett.

Troglocaris Dormitzer, 1853.

1. *Troglocaris schmidti* Dormitzer, 1853.

Distribution: In the waters of the caves of Carniola; caves of Kumpole and Gurk (Dormitzer).

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[31] Ortmann, Arnold E. A Study of the Systematic and Geographical Distribution of the Decapod Family Atyidæ Kingsley. Proc. Acad. Nat. Sci. Phila., 1894, p. 397--416.

Atyaëphyra Brito-Capello, 1866.

1. *Atyaëphira desmarestii* (Millet), 1832.
Distribution: Fresh-water of southern Europe.—Portugal: Coimbra; Southern and Western France; Corsica; Sicily; Dalmatia.

Caridina Milne-Edwards, 1837.

1. *Caridina typus* Milne-Edwards, 1837.
Distribution: Fresh-water of the islands of the Indian Ocean and of Indo-Malayasia; Mauritius; Rodriguez; Seychelles; Siam; Flores; Timor; Saleyer; Celebes; Amboina; Loo Choo.
2. *Caridina americana* Guèrin, 1857.
Distribution: Cuba; Dominica.
3. *Cardinia brevicarpalis* de Man, 1892.
Distribution: Celebes; Amboina.
4. *Cardinia weberi* de Man, 1892.
Distribution: Sumatra; Java; Saleyer; Celebes; Flores.
5. *Cardinia japonica* de Man, 1892.
Distribution: Japan: Kagar, Hayagana.
6. *Cardinia pareparensis* de Man, 1892.
Distribution: Celebes.
7. *Cardinia timarensis* de Man, 1893.
Distribution: Timor.
8. *Cardinia parvirostris* de Man, 1892.
Distribution: Flores.
9. *Cardinia richtersi* Thallwitz, 1891.
Distribution: Mauritius.
10. *Caridina laevis* Heller, 1862.
Distribution: Java.
11. *Caridina multidentata* Stimpson, 1860.
Distribution: Bonin Island; Celebes.
12. *Caridina africana* Kingsley, 1882.
Distribution: S. Africa: Zulu Land.
13. *Caridina fonarum* Heller, 1867.
Distribution: Persia: Schiraz.
14. *Caridina serratirostris* de Man, 1892.
Distribution: Flores; Saleyer; Celebes.

15. *Caridina wycki* (Hickson), 1888.
Distribution: From East Africa to Eastern Australia.—East Africa; Dar-es-Salaam; Ceylon; Celebes; Saleyer; Flores; Timor; Queensland: Burnett.
16. *Caridina nilotica* (Roux), 1833.
Distribution: Northern Africa; Nile; Algiers; River Macta near Oran.
17. *Caridina grandirostris* Stimpson, 1860.
Distribution: Loo Choo Islands.
18. *Caridina gracilirostris* de Man, 1892.
Distribution: Sumatra; Celebes; Saleyer; Flores.
19. *Caridina singhalensis* Ortmann, 1894.
Distribution: Ceylon.
20. *Caridina brevirostris* Stimpson, 1860.
Distribution: Loo Choo.
21. *Caridina pasadenæ* Kingsley, 1896.*
Distribution: Southern California.

Atyoida Randall, 1839.

1. *Atyoida potimirim* F. Müller, 1881.
Distribution: Brazil: Itajahy.
2. *Atyoida bisulcata* Randall, 1839.
Distribution: Hawaiian Islands; Oahn; Tahiti.

Atya Leach, 1817.

1. *Atya moluccensis* de Haan, 1849.
Distribution: Fresh-water of the Indian Archipelago; Sumatra; Java; Batjan; Bali; Celebes; Saleyer; Ceram; Timor; Flores; Amboina; Philippine Islands: Samar.
2. *Atya spinipes* Newport, 1847.
Distribution: *This species represents A. molluccensis in the fresh-water of the Pacific Islands;* Philippine Islands; Caroline, Fiji, Samoa Islands.
3. *Atya brevirostris* de Man, 1892.
Distribution: Flores; Timor; Amboina.
?4. *Atya margaritacea* A. Milne-Edwards, 1864.

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* Added by Prof. Kingsley.

Distribution: New Caledonia.

?5. *Atya robusta* A. Milne-Edwards, 1864.

Distribution: New Caledonia.

6. *Atya scabra* Leach, 1815.

Distribution: Fresh-water of Central America and the West Indies and the Cape Verde Islands.—Mexico; Nicaragua; Cuba; Hayti; Jamaica; Dominica; Martinique; Tobago.—Cape Verde Islands; San Nicolao; San Jagoo.

7. *Atya gabonensis* Giebel, 1875.

Distribution: Gaboon; Orinoco.

8. *Atya crassa* Smith, 1871.

Distribution: Nicaragua; Mexico: Presidio.

I have to thank my friend, Dr. Ortmann, for calling my attention to this paper. I make the following quotations from it: "*Some species of Atyidæ were formerly considered to be marine animals; there is now no doubt that this family contains only fresh-water forms. This family is probably one of the most primitive groups of Decapods living in fresh-water, having immigrated at an early geological period.*" (Italics are mine).

"The geographical range of the Atyidæ embraces the whole of the circum-tropical parts of the world, members of the family being recorded from all the localities explored within these limits. Only in two localities does the range exceed the true tropics; in Japan, where it extends as far north as Tokio, and in the Mediterranean province, where it extends northward to Southern France and Southern Austria." The description by Kingsley of *Caradina pasadenæ* from Pasadena, California, since Ortmann wrote these words hardly makes necessary a modification in them, for Southern California is sub-tropical in its temperature. (Kingsley).

"The most primitive genus, Hiphocaris, shows a distribution the peculiarity of which can only be understood by supposing that the range of this genus was formerly a more extended one, but that in most parts of the world the representatives were exterminated. Only three species survived, one of which lives now in the fresh-waters of the West Indies, the other in Indo-Malaysia, from Japan to Australia, and the third in New Zealand. The closely allied genus Troglocaris, the only species of which might be regarded as a fourth form of Xiphocaris, lives in the subterranean waters of Carinola, a perfectly isolated locality in no way connected with the others named. The third primitive genus, Atyaëphyra, is found near the locality of Troglocaris on the northern borders of the Mediterranean Sea. The scattered localities at which are found the species of these three genera forming the subfamily Xiphocarinæ are no doubt the remains of a more universal distribution in former times; the species now living show the character of true survivals."

"In the subfamily Atyinæ, the genus Atyoida shows a survival character similar to that of the Xiphocarinæ, being recorded from the Sandwich Islands, Tahiti and Southern Brazil."

"The genus Caridina appears to be nearly a circumtropical one. Its range is divided into two very unequal parts; the one comprising the West Indies [and California] and containing only one [two] species, the other comprising a continuous area of the Old World and containing at least nineteen other species. This area extends from South Africa along the east coast to the southern borders of the Mediterranean Sea and to Persia, crossing the islands of the Indian Ocean and Indo-Malaysia to Japan and Australia. It is very probable that further investigations will prove that the range of *Caridina* is a somewhat different one, since fresh-water crustacea of smaller size are mostly neglected by collectors, and the fauna of the fresh-waters of most tropical countries are very little known."

"The distribution of the most extreme genus of the family Atya is somewhat similar to that of Caridina. It is found, like the latter, in the West Indies and Indo-Malaysia, but there are some modifications. One species is known from West Africa, which is identical with another described from the Orinoco, and there is recorded one species from the Cape Verde Islands, identical with the common West Indian form." "The other range of the genus Atya extends over the islands of the Pacific from Sumatra to the Samoan Islands" [and western Central America].

"The conditions of geographical distribution of the Atyidæ are as follows:—

1. The Atyidæ can not endure cooler climates (*climatic barriers*).
2. They are true fresh-water animals (oceans and tracts of land without water form *topographic barriers*).
3. Being animals of an ancient type, they are probably restricted by the occurrence of other fresh-water animals (*bronomic barriers*).
4. The faculties of distribution are very limited.

The Atyidæ are, therefore, confined to the fresh-waters of the tropics and subtropics; the distribution of the genera and species, especially of the more primitive ones, shows a remarkable character of survival. Only Caridina and Atya are of a more recent character, extending over continuous areas within the tropics. Because of the antiquity of the family it has no relations among the recent forms of the littoral regions of the tropical seas."

The following conclusions can be drawn from the distribution of the Atyidæ. The distribution of Cardinia shows that there must have existed a land connection between Africa, the Mascaren Islands, the Seychelles, Persia, Ceylon, the Sunda Islands, the Mollucas, Siam, the Loo Choo Islands, Japan and the Bonin Islands, and between the Mollucas and Australia.

The distribution of Atya shows that this land area extended over the Philippine, Caroline, Fiji and Samoa Islands, and the presence of *Atyoida bisulcata* on the Society and Sandwich Islands, proves that this land extended also to these islands and probably also to the west coast of America (*Atya scabra* Mexico, *Nicaragua* Baur). The presence of *Cardinia paredena* Kingsley, in Lower California is another proof of this connection. The presence of *Atya scabra* on the Cape Verde Islands, and of *Atya gabonensis* in Gaboon and the Orinoco, can only be explained by a former connection of Africa and America (Ortmann).

Geographical Distribution of the Formicidæ of the Pacific Ocean.

The Formicidæ are a very old group. Their first remains have been found in the lowest Jurassic: *Palæomyrmex prodromus* Heer,[32] Lower Lias of Schamblen, Canton Aargau, Switzerland. In the lower Purbeck of Durdlestone Bay, England occur *Formicium brodiei* Westwood, and *Myrmecium heeri* Westwood,[33] and several forms have been described from the Kimmeridgean of Solnhofen, Bavaria. Very rich are the Amber-Beds of the lower Oligocene of the Samland,[34] north of Königsberg, and the well-known Florissant Beds of Colorado. Scudder remarks, that about one-fourth of all the Insects from Florissant are ants, more than 4000 specimens, representing 34 genera and 170 fossil species. Among Miocene localities may be named Oeningen in Baden, and Radoboj in Croatia.[35]

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[32] Heer O. Die Urwelt der Schweiz. Zürich., 1865, p. 91

I now give a list of the distribution of the *Formicidæ* of the Pacific Ocean, from Ihering,[36] with some additions from Emery[37] and Smith.[38] Many of the additional localities have been kindly supplied by Mr. Theo. Pergande of the Department of Agriculture, Washington.

Family FORMICIDÆ,

Subfamily: *Ponerinæ* Mayr.

1. *Ponera insulana* Mayr. Samoa.
2. *Ponera* sp. aff. *contracta* Latr. Sandwich Islands.
3. *Ponera castanea* Mayr. New Zealand.
1. *Ectatomma metallicum* Smith. Samoa, Australia.
2. *Ectatomma mayri* Emery. New Zealand (or Australia?).
3. *Ectatomma brownii* Forel. New Zealand.
1. *Amblypone cephalotes* Smith. New Zealand.
2. *Amblypone saundersii* Forel. New Zealand.
1. *Leptogenys insularis* Smith. Sandwich Islands.

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[33] Westwood J. O. Contributions to fossil entomology. Quart. Journ. Geol. Soc. X, pp. 388, 393, 390, 396, 1854.

[34] Mayr. Gustav Leopold. Die Ameisen des Baltischen Bernsteins. Mit 106, Figuren auf. 5 Tafeln. (Beiträge z. Naturkunde Preussens I), pp. 4, 102, (10), tab. 5. 4° Königsberg, 1868.

[35] Mayr. Gustav Leopold. Vorläufige Studien über die Radoboj-Formiciden Jahrbuch d. k. k. geolog. Reichs-Anstalt, Bd. XVII, p. 47–62, Taf. I, 1867.

[36] Ihering, H. von. Die Ameisen von Rio Grande Sul. Berliner Entom. Zeitschr. Bd. XXXIX, pp. 434–436, 1894.

[37] Emery, C. Notice sur quelques Fourmis des îles Galapagos. Ann. Soc. Entom. France, vol. LXII, p. 89–92, 1893.

[38] Smith, Fred. [Hymenoptera Galapagos]. Proc. Zool. Soc., p. 83, 1877.

1. *Odontomachus hæmatodes* Linn. Tonga, Samoa, Fiji, Borneo, Java, Celebes, Ceylon, Amboina, Australia, Guiana, Columbia, Mexico, Texas, Florida.

2. *Odontomachus angulatus* Mayr. Fiji Islands.

3. *Odontomachus bauri* Emery. Galápagos Islands.

1. *Anochetus græffei* Mayr. Samoa.

Subfamily : *Myrmicinæ* Mayr.

1. *Strumigenis antarctica* Forel. New Zealand.

2. *Strumigenis godeffroyi* Mayr. Samoa.

1. *Orectognathus antennatus* Smith. New Zealand.

2. *Orectagnathus perplexus* Smith. New Zealand.

1. *Monomorium pharaonis* Linn. Samoa, Australia, Chile, La Plata, India, Singapore, Batavia, Manilla, Ceylon, Brazil, Eastern and Southern States, N. A., Egypt, Cape Colony, Italy, France, South Germany, England.

2. *Monomorium speculare* Mayr. Samoa, Tonga, Borneo, India.

3. *Monomorium antarctium* White. New Zealand.

4. *Monomorium suteri* Forel. New Zealand.

5. *Monomorium smithii* Forel. New Zealand.

1. *Cardiocondyla nuda* Mayr. Fiji, Samoa, Tonga, India.

1. *Tetramorium pacificum* Mayr. Tonga, Samoa.

2. *Tetramorium simillimum* Smith. Samoa, Java.

3. *Tetramorium tonganum* Mayr. Tonga.

4. *Tetramorium guineense* Fabr. Fiji, Tonga, Sandwich Is., Galápagos Island, Manilla, Sidney, Madagascar, Cuba, S. Domingo, California.

1. *Vollenhovia samœnsis* Mayr. Samoa.

1. *Huberia striata* Smith. New Zealand.

1. *Solenopsis geminata* Fabr. New Zealand, Tahiti, Sandwich Islands, Chile, La Plata, Brazil.

1. *Pheidole megacephala* Fabr. Sandwich Islands, Ceylon, Madeira, Bahamas, Brazil.

2. *Pheidole sexspinosa* Mayr. Samoa, Ellice Islands.

3. *Pheidole umbonata* Mayr. Samoa, Tonga Islands.

4. *Pheidole oceanica* Mayr. Samoa, Tonga, Ellice Islands.

Subfamily *Dolichoderinæ.*

1. *Tapinoma melanocephala* Fabr. Samoa, Tonga, Galápagos Islands, Singapore, Cayenne, West Indies, Madagascar.

1. *Plagiolepis gracilipes* Smith. India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chili.

1. *Technomyrmex albipes* Smith. Ceylon, Sunda Islands, Samoa, Tonga, India, Hong Kong, Papua.

1. *Tridomyrmex gracilis* Lowne. Samoa, Australia.

2. *Tridomyrmex rufoniger* Lowne. Samoa, Australia.

Subfamily *Camponotinæ* Forel.

1. *Camponotus novæ-hollandiæ* Mayr. Australia, Samoa, Tonga, Ellice Islands.

2. *Camponotus cristatus* Mayr. Fiji Islands.

3. *Camponotus laminatus* Mayr. Fiji Islands.

4. *Camponotus schmeltzi* Mayr. Fiji Islands.

5. *Camponotus sexguttatus* Fabr. Sandwich Islands, South America, Island of Santa Cruz, West Indies, Canary Islands.

6. *Camponotus pallens* Guill. Tonga Islands.

7. *Camponotus pallidus* Smith. Fiji, Tonga, Samoa Islands.

8. *Camponotus subtilis* Smith. Fiji Islands.

9. *Camponotus senex* Smith. Galápagos Islands, Brazil, Central America, Mexico.

10. *Camponotus planus* Smith. Galápagos Islands.

11. *Camponotus macilentus* Smith. Galápagos Islands.

12. *Camponotus peregrinus* Emery. Galápagos Islands.

1. *Colobopsis dentata* Mayr. Fiji Islands.

2. *Colobopsis carinata* Mayr. Fiji Islands.

3. *Colobopsis oceanica* Mayr. Fiji Islands.

4. *Colobopsis nigrifrons* Mayr. Tonga Islands.

5. *Colobopsis conica* Mayr. Tonga Islands.

6. *Colobopsis rufifrous* Smith. Tonga, Fiji, Molluccan Islands.

1. *Prenolepis vividula* Nyl. Tonga, Samoa, Ellice Islands, Australia, Madagascar, Texas.

2. *Prenolepis longicornis* Latr. Samoa, Chile, Senegal, N. America, Batavia, Ceylon, Mexico, Cuba, Madeira.

3. *Prenolepis clandestina* Mayr. Sandwich Islands, Java.

I have very little doubt, that on many groups of Islands, on which, so far as I know, no Formicidæ have been recorded, they will be found, when these Archipelagos will be thoroughly examined; for instance the Pelew and Marianne Islands, the Carolines, the New Hebrides, the Cook, Paumatou, Marquesas and Juan Fernandez.

It is quite evident, that this distribution of the *Formicidæ* cannot be explained by accidental introduction. Also here we are forced to accept a former Pacific Continent.

The *Fiji Islands* have four endemic species of *Camponotus; three* of *Colobopsis;* one of *Odontomachus;* the *Tonga Islands* one endemic species of *Camponotus;* two of *Colobopsis,* one of *Tetramorium;* the *Samoa Islands,* one endemic species of *Anochetus,* one of *Strumigenys* and one of *Vollenhovia;* the *Sandwich Islands* one endemic species of *Ponera,* and one of *Leptogenys;* the *Galapagos Islands* three endemic species of *Camponotus,* and one of *Odontomachus.*

The Fiji, Tonga and Samoa Islands have in common one species of *Camponotus* and one of *Cardiocondyla* (also found in India); the Samoa, Tonga, Ellice Islands and Australia one *Camponotus;* the Fiji, Tonga, Moluccan Islands, one *Colobopsis;* the Sandwich Islands and Java, one *Prenolepis;* Samoa and Australia, two *Tridomyrmex,* one *Ectatomma;* Samoa and Java, one *Tetramorium;* Samoa and Ellice Islands, one *Pheidole;* Samoa and Tonga Islands, one *Pheidole* and one *Tetramorium;* Samoa, Tonga, Sunda Islands, Ceylon, Indi , Hong Kong, Papua, one *Technomyrmex;* Tonga, Samoa, Borneo, India, one *Monomorium;* Samoa, Tonga, Ellice Islands, one *Pheidole;* India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chile, one *Plagiolepis;* one Tahiti, Sandwich Islands, New Zealand, Chile, La Plata, Brazil, one *Solenopsis.*

Distribution of Lacertilia.

We shall now examine the distribution of some genera of Lizards; the data are from Boulenger.[39]

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[39] Boulenger, G. A. Cat. Lizards Brit. Mus. (2nd edit.), vol. I, pp. 147–156, 162–168. London, 1885.

Family *Geckonidæ.*

Gehyra Gray.

1. *Gehyra mutilata* Wiegm. Mascarene Islands: Mauritius and Rodriguez; Seychelles; Ceylon; Birma, Pegu; Malay Peninsula; Indian Archipelago; Philippines: Negros; Celebes; Timor Laut; New Guinea.—Western Mexico: San Blas and Presidio.

2. *Gehyra oceanica* Lesson. Moluccas; New Guinea; Admiralty Islands: Wild Island; Solomon Islands: Faro I.; Shortland Islands; Lord Howe's Island; Fiji Islands; Tonga Islands: Tongatabu; Samoa Islands; Savage Island; Rarotonga Island.

3. *Gehyra vorax* Girard. Loyalty Islands; New Hebrides: Erromango; Fiji Islands; Norfolk Island.

4. *Gehyra brevipalmata* Peters. Pelew Islands.

5. *Gehyra insulensis* Girard. Sandwich Islands.

6. *Gehyra baliola* A. Dum. New Guinea.

7. *Gehyra variegata* Dum & Bibr. Islands of Torres Str.; Murray Island; Sunday Island; Australia: Champion Bay, Houtman's Abrolhos, Peak Downs.

8. *Gehyra australis* Gray. Australia: Swan River, Port Essington, Port Darwin.

Perochirus Boulenger.

1. *Perochirus ateles* A. Dum. Philippines: Mindanaœ.

2. *Perochirus guentheri* Bouleng. New Hebrides: Erromango.

3. *Perochirus depressus* Fischer. Carolines: Ruk Island.

4. *Perochirus articulatus* Fischer. Carolines: Ponape.

5. *Perochirus scutellatus* Fischer. Greenwich Island, south of Carolines.

Lepidodactylus Fitzinger.

1. *Lepidodactylus aurantiacus* Beddome. Southern India.

2. *Lepidodactylus ceylonensis* Boulenger. Ceylon.

3. *Lepidodactylus lugubris* Dum. & Bibr. Malay Peninsula; Celebes; Amboyna; Murray Island; Pelew Islands; New Hebrides, Fiji, Society Islands: Tahiti; Island of Vati, South Pacific.

4. *Lepidodactylus labialis* Peters. Philippines: Mindanao.
5. *Lepidodactylus pulcher* Bouleng. Admiralty Islands.
6. *Lepidodactylus guppyi* Bouleng. Solomon Islands: Faro I.
7. *Lepidodactylus crepuscularis* Bavay. New Caledonia.
8. *Lepidodactylus cyclurus* Günther. New Caledonia.
9. *Lepidodactylus sauvagii* Bouleng. New Caledonia.

There can be little doubt that the Geckonidæ are a very old family of the Lacertilia, which go back at least to the lower Cretaceous, if not to the upper Jurassic. The distribution of the genera enumerated is very instructive.

Gehyra mutilata Wiegm. extends from the Mascarene Islands to the Seychelles, Ceylon, to the Malay Peninsula, Indian Archipelago, Philippines, Moluccas and New Guinea; it also occurs in western Mexico. This distribution again shows that there has been a land area reaching from the Mascaranes to New Guinea. The next species *Gehyra oceanica* Lesson reaches from the Moluccas eastward to the Cook Islands (Rarotonga), being found on the Admirality, Solomon, Fiji, Tonga and Samoa Islands, Savage Island and Lord Howe's Island. *Gehyra vorax* Girard extends this area to the New Hebrides, the Loyalty Islands and Norfolk Island; *Gehyra brevipalmata* to the Pelew group and *Gehyra insularis* to the Sandwich Islands. This distribution can only be explained by a former Indo-Pacific Continent extending from Malaysia to the west coast of America.

The distribution of the species of *Perochirus* Boulenger and *Lepidodactylus* Fitzinger give new proof for the former existence of this continent.

Family *Scincidæ.*

The family Scincidæ contains several genera, showing a very interesting geographical distribution.[39] These genera are Lipinia Gray, Emoa Gray and Ablepharus (*A. boutonii* Desjard).

Lipinia Gray.

1. *Lipinia semperi* Peters. Philippine Islands: Mindanao.
2. *Lipinia pulchella* Steindachu. Philippine Islands.

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[39] Boulenger, G. A. Catalogue of Lizards. Brit. Mus. (Sec. Ed.), vol. III, p. 253-256, p. 290-299, p. 346-348. London, 1887.

3. *Lipinia vulcanica* Girard. Philippine Islands: Caldera, Mindanao.

4. *Lipinia virens* Peters. Southeastern New Guinea.

5. *Lipinia anolis* Bouleng. Solomon Islands.

6. *Lipinia noctua* Lesson. New Guinea, Fiji, Tonga, Samoa, Society and Sandwich Islands.

Emoa Gray.

1. *Emoa cyanura* Lesson. Moluccas; Ternate, Mysol, Timor Laut; New Guinea: Admiralty, Solomon Islands, New Hebrides, Fiji, Savage I., Samoa, Rarotonga, Cook's Islands, Tahiti.

2. *Emoa mivarti* Bouleng. Admiralty Islands: Wild Island.

3. *Emoa cyanogaster* Lesson. Moluccas, New Guinea, Murray Island, Duke of York Island, Solomon Islands and New Hebrides.

4. *Emoa samoënsis* A. Dum. New Hebrides, Fiji, Tonga and Samoa Islands.

5. *Emoa callisticta* Peters & Doria. N. W. Guinea: Soron.

6. *Emoa atrocostata* Lesson. Philippines, Celebes, Moluccas, New Guinea, Santa Cruz and Caroline Islands.

7. *Emoa baudinii* Dum. & Bibr. Celebes, Moluccas, New Guinea.

8. *Emoa singaporensis* Steindachn. Singapore.

9. *Emoa nigra* Hombr. & Iacq. Caroline Islands, New Ireland, Solomon, Banks's, Fiji and Samoa Islands.

10. *Emoa adspersa* Steind. Fiji and Samoa Islands; Savage Island.

11. *Emoa parietalis* Peters. Borneo: Sarawak.

12. *Emoa jerdoniana* Stoliczka. Pinang.

13. *Emoa breviceps* Peters. Gaboon, Camaroons.

Ablepharus boutonii Desjard.

1. *boutonii* Desj. Mauritius, Zanzibar, Mozambique, Comoro Islands.

2. *A. boutonii pœcilopleurus* Wiegm. Peru: Pisacoma Islands; Puna Island, Gulf of Guayaquil; Sandwich Islands; Savage Island; Aldabra (Stejneger).[40]
3. *A. boutonii peronii* Cocteau. Java; Timor; Timor Laut; Amboina; Fly River, New Guinea; Murray Island; Islands of Torres Straits; W. Australia; Tasmania, Fiji Islands; Samoa, and Society Islands, New Hebrides, New Caledonia.
4. *A. boutonii rutilus* Peters. Fly River, New Guinea.
5. *A. boutonii metallicus* Boulenger. North Australia.
6. *A. boutonii quinquetæniatus* Günther. West coast of Africa.
7. *A. boutonii cognatus* Böttg. Nossi Bé, Madagascar.
8. *A. boutonii gloriosus* Stejneger. Glorioso Island.[40]

The genus Lipinia is found on the Philippines, New Guinea, Solomon Islands, Fiji, Tonga, Samoa, Society and Sandwich Islands; Emoa in Pinang; on the Moluccas New Guinea, Admiralty, Duke of York Island, New Ireland; Solomon Islands, New Hebrides, Fiji, Tonga, Samoa Islands. Tahiti, Savage Island; Rarotonga and Carolines and one species in W. Africa. *Ablepharus boutonii* Desjard. shows a most interesting distribution. West coast of Africa, Madagascar; Mauritius, Comoro Islands, Glorioso Island, Zanzibar, Mozambique; —Java, Timor, Moluccas, New Guinea, Islands of Torres Straits, North Australia, West Australia, Tasmania; New Caledonia; New Hebrides, Fiji, Samoa, and Society Islands, Savage Island, Sandwich Islands, Puna Island, Gulf of Guayaquil, Pisacoma Islands, Peru.

The distribution of these genera is only to be explained by the former existence of an Indo-Pacific Continent.

The Distribution of the Hydrophidæ.

This family is found in the Pacific; but in the Indian Ocean it only reaches west to the Persian Gulf.[41] It is totally absent from the Atlantic, and the whole African portion of the Indian Ocean. The Hydrophidæ extend north to Japan, south to Tasmania and New Zealand; east to the west-coast of America from Mexico to Ecuador. Only one species is found on this coast *Hydrus platurus* Linn.; recorded from Salina Cruz, Mexico; Panama; and off the coast of Ecuador.

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[40] Stejneger, Leonhard. On some collections of Reptiles ana Batrachians from East Africa and the adjacent islands, recently received from Dr. W. L. Abbott and Mr. William Astor Chandler, with descriptions of new species. Proc. U. S. Nat. Mus., vol. XVI, p. 711–741. [No. 970]. Washington, 1893.

[41] Boulenger, G. A. Catalogue of Snakes. Brit. Mus., vol. III, p. 264–309, 1896.

This family is certainly younger than Miocene, since no members of it, are found in the Westindian Sea. It probably became much differentiated after the formation of the Indo-pacific Ocean.

The geographical distribution of different genera of Birds on the Pacific Islands.

Let us consider the distribution of different genera of the COLUMBIÆ. Our knowledge of the fossil Columbæ commences with the lower miocene of Allier in France, *Columba calcaria* Miln. Edw. The very peculiar group, represented by the Dididæ (Didus and Pezophaps) from the Mascarene Islands, Mauritius and Bourbon, were exterminated long ago. Living specimens of (*Didus ineptus*) were seen as late as in 1679; of *Pezophaps solitarius* (the Solitaire) in 1761.

The Columbidæ are certainly geologically an old group.

Family TRERONIDÆ.

Subfamily *Ptilinopodinæ.*

Distribution of the genus Ptilinopus Swainson, 1825 (from Salvadori).[42]

1. *Ptilinopus flavicollis* Finsch & Hartl. Timor and Flores.
2. *Ptilinopus xanthogaster* Wagl. Banda, Khoor, Ké, Tenimber Islands, Damma Island, and Lettie.
3. *Ptilinopus ewingi* Gould. Northern Australia from Port Essington to Cape York.
4. *Ptilinopus swainsoni* Gould. Eastern Australia from Cape York to New South Wales, the Islands in Torres Strait and S. E. New Guinea.

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[42] Salvadori T. Catalogue of the Columbæ or Pigens in the collection of the British Museum, p. 83–112. London, 1893. Catalogue of the Birds in the British Museum, vol. XXI. London, 1893.

5. *Ptilinopus richardsi* Rams. Solomon Islands: Ugi.

6. *Ptilinopus greyi* G. R. Gray. New Caledonia, with Island of Pines; Loyalty Islands: Livu; New Hebrides: Erromango, Aniva, Vatè, Mallicolo; Santa Cruz Islands: Vanicoro.

7. *Ptilinopus perousei* Peale. Fiji, Tonga and Samoa Islands.

8. *Ptilinopus porphyraceus* Temm. Fiji, Tonga Islands and Savage Island.

9. *Ptilinopus fasciatus* Peale. All the Samoan Islands.

10. *Ptilinopus rarotongensis* Hartl. & Finsch. Rarotonga.

11. *Ptilinopus purpuratus* Gmel. Society Islands: Tahiti.

12. *Ptilinopus chrysogaster* G. R. Gray. Society Islands: Huaheine and Raiatea.

13. *Ptilinopus huttoni* Finsch. Austral Group: Island of Rapa.

14. *Ptilinopus coralensis* Peale. Paumotu Group: Island of Carlsoff.

15. *Ptilinopus smithsonianus* Cass. Paumotu Group (some Island).

16. *Ptilinopus dupetit-thouarsi* Néboux. Marquesas: Christina, Nukahiwa.

17. *Ptilinopus mercieri* Des Murs & Prév. Marquesas Islands: Nukahiwa.

18. *Ptilinopus tristrami* Salvad. Marguesas: Hivaoa.

19. *Ptilinopus pelewensis* Hartl. & Finsch. Pelew Islands.

20. *Ptilinopus ponapensis* Finsch. Eastern Carolines: Ruck group.

21. *Ptilinopus hernsheimi* Finsch. Eastern Carolines: Kushai.

22. *Ptilinopus roseicapillus* Less. Ladrone or Marianne Islands.

Chrysœnas Bonaparte, 1854.

This genus is confined to the Fiji Islands. There are three species, each confined to special islands of the group.[42]

1. *Chrysœnas luteovirens* Hombr. & Jacg. Fiji Islands: Balau, Ovalau, Viti Levu.

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[42] Salvadori, l. c., p. 155–158.

2. *Chrysœnas victor* Gould. Fiji Islands: Bua, Vanua Levu, Taviuni, Nyami, Lanthala.
3. *Chrysœnas viridis* Layard. Fiji Islands: Kandavu.

Drepanoptila Bonaparte, 1855.

This genus with the single species *Drepanoptila holosericia* Temm. & Knip. is confined to New Caledonia, with the Isle of Pines.[42]

The geographical distribution of these genera is very interesting.

Ptilopinus. The Moluccas have two peculiar species confined to different islands; *Northern Australia* has one, and Eastern Australia with the Island of Torres Strait another peculiar species. Seventeen species are found on the following islands: Solomon I., New Caledonia, Loyalty I., New Hebrides, Santa Cruz Islands, Fiji, Tonga, Samoa, Savage Island; Raratonga, Society Islands; Austral group: Island of Rapa; Paumotu group: Island of Carlsoff; some Island of Paumotu group; Marquesas; Pelew; Eastern Carolines: Ruck group: Kushai; Ladrone Islands. Of these 17 species, 15 are confined to special islands. This fact and the differentiation of the genus *Chrysoenas* restricted to Fiji Islands, into three peculiar species confined to special islands, and *Drepanoptila* with a single species on New Caledonia shows that these many islands were not stocked by immigrants, but that they were formerly connected to form a continent.

The genus *Alectroenas* G. R. Gray, 1840, which belongs to the subfamily Ptilinopodinæ is confined to the Madagascarian region.[42] There are four species:

1. *Alectroenas madagascariensis* Linn. Madagascar with Nossibe Isl.
2. *Alectroenas nitidissima* Scop. Mauritius.
3. *Alectroenas sganzini* Des Murs. Comoro Islands.
4. *Alectroenas pulcherrima* Scop. Seychelles Islands.

This again shows the close relationship between the Madagascarin and the Indo-Pacific region, which, as we have seen before, can only be explained by former land connection.

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[42] Salvadori, l. c., p. 158–160.

[42] Salvadori, l. c., p. 160--165.

Subfamily *Carpophaginæ*.[42]

Serresius Bonaparte, 1855.

This genus is restricted with a single species, *S. galeatus* Bonap., to the Marquesus Islands.

Globicera Bonaparte, 1854.

1. *Globicera pacifica* Gmel. From the Samoa Islands on the east to New Guinea; Port Moresby, New Guinea; New Hebrides; Louisiade Archipelago; Fiji Islands; Tonga Islands; Samoa Islands.
2. *Globicera myristicivora* Scop. Western New Guinea and the surrounding western Papuan Islands; Waigiou, Mysol.
3. *Globicera rubricera* G. R. Gray. New Ireland; New Britain; New Hanover and Duke of York Island.
4. *Globicera rufigula* Salvad. Solomon Islands.
5. *Globicera oceanica* Less. Carolines and Pelew Islands.
6. *Globicera aurorœ* Peale. Aurora or Maitea Island, Society group.
7. *Globicera wilkesi* Peale. Tahiti, Society group.

The species of these two genera are found from the Papuan Islands and New Guinea to the Marquesas Islands.

Family COLUMBIDÆ.[42]

Subfamily *Columbinæ*.

Janthoenas Reichenbach, 1852.

1. *Janthoenas palumboides* Hume. Andamanes and Nicobars.
2. *Janthoenas janthina* Temm. Japan and Loo Choo Islands.
3. *Janthoenas jouyi* Stejneg. Loo Choo Islands.
4. *Janthoenas versicolor* Stejneg. Bonin Islands.
5. *Janthoenas nitens* Stejneg. Bonin Islands; Parry group: Bailey Islands and Sulphur Islands.
6. *Janthoenas griseogularis* Wald. & Layard. Philippine Islands, from Luzon to Mindanao; and also Sulu Islands and N. Borneo.

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[42] Salvadori, l. c., p. 171--181.

[42] Salvadori, l. c., p. 308--319.

7. *Janthoenas metallica* Temm. Timor.

8. *Janthoenas albigularis* Bonap. From the Halmahera and Amboyna groups through the Papuan Islands to the Louisiades.

9. *Janthoenas pallidiceps* Rams. Duke of York Island.

10. *Janthoenas philippana* Rams. Solomon Islands; Ugi.

11. *Janthoenas hypoenochroa* Gould. New Caledonia; Isle of Pines; Loyalty Islands.

12. *Janthoenas leopoldi* Tristr. New Hebrides.

13. *Janthoenas vitiensis* Quoy & Gaim. Fiji Islands.

14. *Janthoenas castaneiceps* Peale. Samoa Islands.

This genus shows a very extensive distribution; Andamans and Nicobars, N. Borneo, Sulu Islands, Philippines, Loo Choo Islands, Japan, Bonin Islands, Timor, Halmahera group, Amboina group, Papuan Islands, Louisiade Archipelago, Duke of York Islands, Solomon, New Hebrides, Loyalty Islands, New Caledonia, Fiji Islands, Samoa Islands.

This distribution is easily explained by the former land connection of the different islands.

Family PERISTERIDÆ.

Subfamily *Geotrigonidæ*.[42]

Genus *Phlegoenas* Reichenbach, 1851.

1. *Phlegoenas luzonica* Scop. Luzon, Philippines.

2. *Phlegoenas crinigera* Reichenb. Mindanoa, Basilan, Philippines.

3. *Phlegoenas platenæ* Hartert. Mindoro, Philippines.

4. *Phlegoenas tristigmata* Temm. N. Celebes, Menado.

5. *Phlegoenas bimaculata* Salvad. S. Celebes, Makassar.

6. *Phlegoenas rufigula* Pucher. & Jacq. New Guinea, with the N. W. Papuan Islands: Waigiou, Salawatti, Mysol and Jobi.

7. *Phlegoenas helviventris* Rosenb. Aru Islands and southern New Guinea.

8. *Phlegoenas beccarii* Salvad. N. W. New Guinea.

9. *Phlegoenas margaritæ* D'Alb. & Salvad. New Guinea, Jobi, Duke of York Island, New Britain.

[42] Salvadori, l. c., p. 583--604.

10. *Phlegoenas johannæ* Sclat. Duke of York Island.
11. *Phlegoenas granti* Salvad. Guadalcanar, Solomon Islands.
12. *Phlegoenas vitiensis* Finsch. Fiji Islands.
13. *Phlegoenas stairi* G. R. Gray. Tonga Islands.
14. *Phlegoenas samoensis* Finsch & Hartl. Samoa Islands.
15. *Phlegoenas canifrons* Hartl & Finsch. Pelew Islands.
16. *Phlegoenas virgo* Reichenow. Pelew Islands.
17. *Phlegoenas pampusan* Quoy et Gaim. Marianne or Ladrone Islands.
18. *Phlegoenas kubaryi* Finsch. Ruk I., Carolines.
19. *Phlegoenas erythroptera* Gmel. Eimeo, Society Islands.
20. *Phlegoenas albicollis* Salvad. Bow Island, Paumotu Islands.
21. *Phlegoenas pectoralis* Peale. Carlsoff, Paumotu Islands.
22. *Phlegoenas yapensis* Hartl. & Finsch. Uap, Mackenzie Islands.

The genus *Phlegoenas* shows a very extensive differentiation of species on the different groups of islands. On the Philippines there are three species, two confined to single islands, and the third to two other islands. Celebes has a peculiar species on the north and one on the south end. One species is found on the N. W. Papuan Islands and New Guinea, another one on the Aru Islands and southern New Guinea, a third one is on New Guinea, Duke of York Island and New Britain. All the other 14 species are restricted to single localities: New Guinea; Duke of York Island; Guadalcanar, Solomon Islands; Fiji Islands; Tonga Islands; Samoa Islands; two to the Pelew Islands; Marianne Islands; Ruk Island, Carolines; Eimeo, Society Islands; Bow Island, Paumotu group; Carlshoff, Paumotu group; Uap, Mackenzie Islands.

This peculiar differentiation of Phlegoenas can only be explained by the former connection of these islands, and not by accidental immigrants. This is another proof for the former existence of a Pacific Continent.

I shall now discuss the geographical distribution of two genera of the Sturnoid Passerine Birds, the Sturniformes.

Section STURNIFORMES.

Family *Sturnidæ.*

Subfamily *Sturninæ.*[43]

Genus *Aplonis* Gould, 1836.

1. *Aplonis cantor* Müll. Mysol, Salawatti, Batanta, New Guinea, Louisiade Islands, Admirality groups of islands, New Britain, Duke of York Island, Solomon Islands.
2. *Aplonis feadensis* Ramsay. Fead Island.
3. *Aplonis crassa* Scl. Tenimber Islands, Larat, Timor Laut.
4. *Aplonis rufipennis* Layard. New Hebrides.
5. *Aplonis atronitens* Gray. Loyalty Islands.
6. *Aplonis striata* Gmel. New Caledonia, Isle of Pines.
7. *Aplonis fuscus* Gould. Norfolk Island and Lord Howe's Island.
8. *Aplonis vitiensis* Layard. Fiji Islands, Rotumah Island, (north of Fiji Islands).
9. *Aplonis tabuensis* Gmel. Tonga Islands.
10. *Aplonis fortunæ* Layard. Fortuna Island (between Fiji and Samoa Islands).
11. *Aplonis brunnescens* Sharpe. Savage Island.
12. *Aplonis atrifusca* Peale. Samoa Islands.
13. *Aplonis brevirostris* Peale. Samoa Islands.
14. *Aplonis cinerascens* Hartl. & Finsch. Rarotonga, Cook Islands.
15. *Aplonis inornata* Sharpe. Raiatea, Society Islands.
16. *Aplonis kittlitzi* Finsch. & Hartl. Carolines, Ponapé, Kuschai, Ruk and Lugunor.
17. *Aplonis pelzelni* Finsch. Interior mountains of Ponapé.

Family PLOCEIDÆ.

Subfamily *Viduinæ.*

Genus *Erythrura* Swainson, 1837.

1. *Erythrura prasina* Sparrm. From Southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo.

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[43] Sharpe, R. Bowdler. Catalogue of the Passeriformes, or Perching Birds in the collection of the Brit. Mus. Sturniformes. London, 1890, p. 125--137, p. 380--387. Catalogue of the Birds in the Brit. Mus., Vol. XIII. London, 1890.

2. *Erythrura forbesi* Sharpe. Tenimber Islands.
3. *Erythrura tricolor* Vieill. Timor.
4. *Erythrura trichroa* Kittl. Ternate, New Guinea, Carolines, Solomon Islands.
5. *Erythrura psittacea* Gmel. New Caledonia.
6. *Erythrura cyaneifrons* E. L. Layard. Lifu, Loyalty Islands, Tanna, New Hebrides.
7. *Erythrura serena* Scl. Island of Aneitum, New Hebrides.
8. *Erythrura regia* Scl. Island of Api, New Hebrides.
9. *Erythrura pealii* Hartl. Reva, Taviuni, Fiji Islands.
10. *Erythrura kleinschmidti* Finsch. Viti Levu, Fiji Islands.
11. *Erythrura cyanovirens* Peale. Samoa Islands.

Of the seventeen species of Aplonis only one, *A. cantor* Müll., has a more extensive distribution. It extends from Mysol, Salavati, Batanta, small islands at the west end of New Guinea, through New Guinea and the Louisiade Islands, and from the Admiralty Islands, New Britain and Duke of York Island to the Solomon Islands. *A. fuscus* Gould, occurs on Norfolk and Lord Howe's Island. The other fifteen species are restricted to special localities: Tenimber Islands; Fead Island; New Hebrides; Loyalty Islands; New Caledonia, with Isle of Pines; Fiji Islands and Rotumah Island; Tonga Islands; Fortuna Island; Savage Island; two Samoan Islands; Rarotonga Island; Raiatea, Society Islands; Carolines: Ponapé, Kuschai, Ruk and Lugunor; Interior mountains of Ponapé.

The genus Erythrura Swainson, also shows a very interesting distribution; *E. prasina* Sparrm., is found from southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo; *E. trichroa* Kittl., on the Moluccas, New Guinea, Carolines and Solomon Islands; *E. cyaneifrons* E. L. Layard, on the Loyalty Islands and the New Hebrides. The remaining eight species have special localities: Tenimber Islands; Timor; New Caledonia; Island of Aneitum, New Hebrides; Island of Api, New Hebrides; Rewa, Taviuni, Fiji Islands; Viti Levu, Fiji Islands; Samoa Islands.

The peculiar differentiation of Aplonis and Erythrura on the different groups of islands can only be explained by their continental origin.

The distribution of the genus Myzomela of the Honey-eaters or Honey-suckers may next be considered.

Group CINNYRIMORPHÆ.[44]

Family *Meliphagidæ.*

Subfamily *Myzomelinæ.*

Genus *Myzomela* Vigors and Horsfield, 1826.

1. *Myzomela chloroptera* Walden. Celebes.
2. *Myzomela wakoloensis* H. O. Forbes. Island of Bourou.
3. *Myzomela simplex* Gray. Halmahera Group.
4. *Myzomela rubrobrunnea* Meyer. Misori Island in the Bay of Geelwink.
5. *Myzomela rubrotincta* Salvad. Obi Island.
6. *Myzomela boiei* S. Müller. Banda Islands.
7. *Myzomela vulnerata* S. Müller. Timor.
8. *Myzomela annabellæ* Sclater. Tenimber Group: Loetoer Island.
9. *Myzomela adolphinæ* Salvad. New Guinea, Arfac Mountains.
10. *Myzomela rosenberyi* Schleg. New Guinea: Astrolabe Mountains.
11. *Myzomela eques* Less. New Guinea, Dorey and Mysol Island.
12. *Myzomela nigrita* Gray. Western and Southern New Guinea and Aru Islands.
13. *Myzomela erythrocephala* Gould. Northern Australia to Aru Islands and New Guinea.
14. *Myzomela forbesi* Ramsay. Woodlark Islands, north of Louisiade Islands.
15. *Myzomela guentheri* Gadow. New Britain.
16. *Myzomela cineracea* Scl. New Britain.
17. *Myzomela cruentata* Meyer. New Guinea, New Ireland, New Britain.

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[44] Gadow, Hans. Catalogue of the *Passeriformes*, or Perching Birds, in the collection of the British Museum. *Cinnyrimorphæ* containing the Families Nectarinidæ and Meliphagidæ (Sun-Birds and Honey-Eaters). London, 1884, p. 128--144. Catalogue of the *Birds* in the British Museum, Vol. IX, London, 1884.

18. *Myzomela sclateri* Forbes. Palakuru Island, off New Britain.

19. *Myzomela sanguinolenta* Creeper. Australia.

20. *Myzomela nigra* Gould. Greater part of Australia.

21. *Myzomela pectoralis* Gould. North Australia.

22. *Myzomela obscura* Gould. North Australia and opposite parts of New Guinea.

23. *Myzomela pulcherrima* Ramsay. Solomon Islands, Ugi.

24. *Myzomela cardinalis* Gmel. New Hebrides.

25. *Myzomela caledonica* Forbes. New Hebrides to New Caledonia.

26. *Myzomela jugularis* Peale. Fiji Islands.

27. *Myzomela nigriventris* Peale. Samoa Islands.

28. *Myzomela rubrata* Less. Caroline Islands.

29. *Myzomela chermesina* Gray. Caroline Islands, Ponapé Island, New Hebrides, Rotumah (north of Fiji).

Myzomela has a very extensive distribution, reaching from Celebes over the Moluccas, Papuan Islands, New Guinea to Australia. From New Britain and New Ireland (Bismarck Archipelago) to the Solomon Islands, New Hebrides, New Caledonia, Fiji, Samoa Islands, Rotumah, Carolines.

Of the 29 species, 21 are restricted to special localities. Here we have again the peculiar differentiation, which can only be explained by former land connection.

Subfamily *Zosteropinæ*.

Genus Zosterops Vigors & Horsfield,[44] 1827.

The genus Zosterops has the most remarkable geographical distribution. *Range:* All over Africa south of the Sahara; Island of St. Thomas and Prince's Island in the Bight of Benin, W. Africa; Socotra; Madagascar; the Mascarene Islands; Comoro; Glorioso; Seychelles Islands; entire Indian peninsula and Ceylon; Burmese countries; the whole of China, extending into Amoor Land; Japan; Formosa; Hainan; Malay peninsula; all the Indo-Malayan islands; Moluccas; New Guinea and adjacent Papuan Islands; throughout the islands of the Pacific Ocean (with a few exceptions); New Caledonia; Lord Howe's Island; Norfolk Island; Australia with Tasmania, New Zealand, Chatham Islands.

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[44] Gadow, l. c., p. 146--203.

Gadow enumerated in 1884 eighty-five species of Zosterops. The number of species known to-day must certainly be much greater. The differentiation into species is very remarkable, and a great many are restricted to single islands. I mention the following species.

1. *Zosterops cærulescens* Lath. Australia; New Zealand; Chatham Island.

2 and 3. *Zosterops albigularis* Gould and *Z. tenuirostris* Gould. Norfolk Island.

4. *Zosterops strenua* Gould. Lord Howe's Island.

5. *Zosterops tephropleura* Gould. Lord Howe's Island.

6. *Zosterops griseonata* Gray. New Caledonia and Erromango, New Hebrides.

7. *Zosterops vatensis* Tristr. Vate, New Hebrides.

8. *Zosterops flavifrons* Lath. Aneitum, Erromango, New Hebrides.

9. *Zosterops inornata* E. L. & C. L. Layard. Lifu, Loyalty Islands.

10. *Zosterops minuta* E. L. & C. L. Layard. Lifu, Loyalty Islands.

11. *Zosterops melanops* Gray. Loyalty Islands.

12. *Zosterops flaviceps* Peale. Levuka, Ovalau, Taviuni, Fiji Islands.

13. *Zosterops explorator* Layard. Kandavu, Levuka, Ovalau, Fiji Islands.

14. *Zosterops hypolais* Hartl. & Finsch. Island of Uap, Mackenzie Group.

15. *Zosterops oleagina* Hartl. & Finsch. Island of Uap, Mackenzie Group.

16. *Zosterops cinerea* Kittl. Kushai Island, E. Carolines.

17. *Zosterops ponapensis* Finsch. Island of Ponapé, Carolines.

18. *Zosterops semperi* Hartl. & Finsch. Eastern and Central Carolines; Pelew Islands.

19. *Zosterops finschii* Hartl. Pelew Islands.

20. *Zosterops conspicillata* Kittl. Island of Guam, Ladrones.

21. *Zosterops rendovæ* Tristram. Island of Rendova, Solomon Islands.

22. *Zosterops hypoxantha* Salvad. New Britain.

23. *Zosterops griseotincta* Gray. Louisiade Islands.

24. *Zosterops xanthochroa* Gray. New Caledonia and the Isle of Pines.

25. *Zosterops grayi* Wall. Kê Islands, Moluccas.

26. *Zosterops aureigula* Salv. Island of Jobi, Bay of Geelwink, N. W. New Guinea.

27. *Zosterops chloris* Bonap. Banda Island, Moluccas.

28. *Zosterops buruensis* Salvad. Island of Bouru, Moluccas.

29. *Zosterops uropygialis* Salvad. Little Kê Island, Moluccas.

30. *Zosterops atriceps* Gray. Island of Batchian, Moluccas.

31. *Zosterops fuscifrons* Salvad. Halmahera, Moluccas.

32. *Zosterops mysoriensis* Meyer. Misori Bay of Geelwink, N. W. New Guinea.

33. *Zosterops longirostris* Ramsay. Heath Island, southeastern end New Guinea.

34. *Zosterops griseiventer* Sclater. Tenimber Islands.

35. *Zosterops citrinella* Bonap. Timor.

36. *Zosterops muelleri* Hartl. Timor.

37. *Zosterops aureifrons* Wallace. Flores and Sumbawa.

38. *Zosterops gallio* Salv. Java.

39. *Zosterops javanica* Horsf. Java.

40. *Zosterops fallax* Gadow. Java and Sumatra.

41. *Zosterops frigida* Hartl. Sumatra.

42. *Zosterops atricapilla* Salv. Mount Singalan, Sumatra.

43. *Zosterops chlorates* Hartl. Mount Dempo, Sumatra, 8000 feet.

44. *Zosterops flava* Horsf. Java, Sumatra and Borneo. Bornean specimens lighter.

45. *Zosterops atrifrons* Wallace. Celebes.

46. *Zosterops everetti* Tweed. Philippine Islands: Dinagat.

47. *Zosterops meyeni* Bonap. Philippine Islands: Luzon.

48. *Zosterops japonica* Temm. & Schleg. Japan.

49. *Zosterops ceylonensis* Holdsw. Hills of Ceylon.

50. *Zosterops palpebrosa* Temm.[45] All over India from the Himalayas to Ceylon with the Laccadives; Burmese countries eastwards into South China; Andamans and Nicobars.

51. *Zosterops abyssinica* Guérin. Socotra Island, also Abyssinia, 3000–10,000 feet high.

52. *Zosterops anjuanensis* E. Newton. Comoro group: Anjuan and Grand Comoro Islands.

53. *Zosterops madagascariensis* Gmel. Madagascar and Glorioso Islands.

54. *Zosterops kirki* Shelley. Grand Comoro Island.

55. *Zosterops modesta* E. Newton. Seychelles.

56. *Zosterops semiflava* E. Newton. Seychelles: Marianne Island.

57. *Zosterops mayottensis* Schleg. Island of Mayotte.

58. *Zosterops mauritiana* Gmel. Mauritius.

59. *Zosterops borbonica* Gmel. Bourbon or Island of Réunion.

60. *Zosterops olivacea* Linn. Bourbon or Réunion'

61. *Zosterops chloronota* Gray. Mauritius.

62. *Zosterops lugubris* Hartl. Island of S. Thomas in the Bay of Biafra, W. Africa.

63. *Zosterops leucophæa* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

64. *Zosterops ficedulina* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

Of the 85 species of Zosterops mentioned by Gadow, 61 are restricted to special localities, and of these 58 to special islands or island groups. This genus traverses Africa from the west (islands in the Bay of Biafra) to the east (Abyssinia and Socotra). It is found on all the islands on the southeast coast of Africa, Madagascar, Comoro Islands, Grand Comoro, Island of Mayotte, Glorioso Islands, the Mascarenian Islands, Bourbon and Mauritius, Aldabra and the Seychelles. The next localities eastwards are the Laccadives, Ceylon, the whole of India with the Himalayas; then follow the Burmese countries to southern China and north to southern Amoor Land; it occurs also on the Andaman and Nicobar Islands. Japan has a peculiar species, but the greatest differentiation is found on the Sunda Islands, Celebes and especially the Moluccas, and the numerous small islands and groups of islands known as the Papuan Islands. From New Guinea Zosterops ranges over to Australia, Tasmania, New Zealand and the Chatham Islands. Peculiar species are found on Lord Howe's (2) and Norfolk Islands (2); New Caledonia, the Loyalty Islands (3); New Hebrides (2); Fiji Islands (3); Carolines (3); Mackenzie Group (2); Pelew Islands; Ladrones; Solomon Islands: Rendove; Louisiade Islands; New Britain.

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[45] Gadow believes that all the specimens from these localities belong to *Z. palpebrosa* Temm. It would be strange if this species is different from the others, which have often very restricted localities.

The extensive distribution of Zosterops and the very great differentiation into many species on islands which are often close together, or separated by very great distances from each other, can only be explained by postulating the existence of a former continent.

(*To be continued.*)

EDITOR'S TABLE.

THE meeting of the British Association, held in Toronto in August, was a success in every respect. The attendance (some 1300) was large, the addresses were good and many of the papers read were important, while the city of Toronto outdid itself in entertaining its guests. The way in which the spirit of the Victorian Jubilee was manifested was noticeable, and the guests could not but realize that they were attending the meeting of a British Association. We do not mean to infer by this that the guests were made uncomfortable, but that the national feeling could not help showing itself, in spite of such utterances as those of Sir John Evans in his Presidential Address, when he said:

"Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister association of the United States of America—still mourning the loss of her illustrious President, Professor Cope—and some other learned societies have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions and aiding us in an inter-